COMPARATIVE EFFECT OF UPHILL RUNNING AND INTERVAL TRAINING ON SELECTED PHYSICAL, PHYSIOLOGICAL VARIABLES AND PLAYING ABILITY OF YOUNG SOCCER PLAYERS

Synopsis

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Abstract

This study investigates the comparative impact of two prominent training methods—uphill running and interval training—on the physical fitness, physiological functions, and soccer playing ability of young male soccer players aged 15–20 years. Despite soccer's popularity worldwide, India continues to lag behind in global performance, often due to the lack of structured, scientifically-driven training interventions at the grassroots level. To address this, 45 female players from a residential football academy were randomly assigned into three groups: Uphill Running, Interval Training, and a Control group. Each experimental group underwent a 12-week regimen involving sport-specific drills focused on speed, endurance, strength, and agility.

Key performance indicators—such as speed, cardiovascular endurance, explosive leg strength, anaerobic power, vital capacity, and soccer-specific skills (dribbling, shooting, passing)—were assessed both before and after the intervention using standardized tests. The study employed ANCOVA and t-tests to analyze the data. Results are expected to reveal which training method more effectively enhances the selected variables and contributes significantly to improved soccer performance. The findings aim to inform coaches, trainers, and physical educators about the optimal conditioning strategies for youth soccer development in India.

Keywords:

Uphill Running, Interval Training, Female Soccer, Physical Fitness, Anaerobic Power, Youth Athletes, Training Methods, Playing Ability, Agility, Vital Capacity.

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CHAPTER I

INTRODUCTION

"The five S's of sports training are stamina, speed, strength, skill and spirit; but the greatest of these is spirit"

-Ken Doherty

Throughout the years, sportspersons have been continuously breaking barriers and creating records, predicted as impossible or far-fetched by physiologists and experts working in the field. As a wonderfully-created machine, the human body is capable of stretching the limits, as proven and demonstrated by remarkable, outstanding players. However, all these does not happen overnight and to ordinary people. The records etched, incredible feats achieved are a result of intense, systematic training combined with the unyielding attitude to succeed. Equally worth mentioning is the guidance and conviction shown by personnels involved with the sportsperson- coach, physiotherapist, psychologist, etc. A fine combination of all these factors are crucial for success and achievement of goals by the athlete. In all totality, they form what we commonly call sports training.

A big difference exists between contemporary elite and previous generation athletes. Even though the goals and objectives remain the same, the process of training have tremendously changed overtime to achieve success. Performing exceptionally well requires long-term planning, sustainability and commitment. Therefore, high-performance sports is not something achievable by the ordinary amateur but it is a goal requiring meticulous planning and consideration. Top players have been carefully trained since childhood by being identified to be genetically gifted and talented. Thereafter, they are exposed to training and competitive environment, aimed at constructing a world class performer (David & Lewindon, 2014).

Generally, the process of sports training involves preparation of a sportsperson through the performance of a variety of exercises, to improve, maintain or attain highest level of performance. However, it is not the mere execution of the exercises, but also factors like training loads, recovery, sports equipment, nutrition, psychological training that should be adopted to ensure the realization of the optimal benefits of training (Uppal, 2002).

Football, being a high-intensity, multi-dimensional sport requires mental grit, physical fitness and mastery over techniques. A top football player covers an estimated 10 to 12 km each game. However, this feat is not limited to merely running back and forth but requires the player to be excellent in aspects like muscular

endurance, explosive power, speed, agility and also integrating manipulation of ball and maneuvering the environment. It is a very challenging activity and conditioning has become a major part of the game. A player needs to be physically fit and it is imperative that conditioning exercises be performed religiously. This ensures that players are quicker, stronger, and have better stamina to gain an edge over the opposition players (Cresser, 2012).

STATEMENT OF THE PROBLEM

The main purpose of the study is to investigate the comparative effect of uphill running and interval training on soccer playing ability and selected variables of young soccer players.

RESEARCH QUESTIONS

The researcher will seek to find answers to the following research questions:

1. Will there be a difference in physical variables as a result of the two types of trainings (Uphill running and interval training)?
2. Will there be a difference in physiological variables and performance as a result of the two-training intervention (Uphill running and interval training)?
3. If a difference is found out, which training is better at improving the selected variables?
4. Which training method will be the best in improving performance of the soccer players?

OBJECTIVES OF THE STUDY

The objective of the study are as follows;

1. To compare the effects of uphill running and interval training on overall playing ability, physical and physiological variables of young soccer players.
2. To find the differences in the effects of uphill running and interval training on soccer playing ability and selected variables.
3. To find the effect of time (i,e ,12 weeks) on selected variables.

DELIMITATIONS

1. The study will be delimited to 45 female soccer players of a residential football academy.
2. The age range of the soccer players will be between 16-20 years.
3. The specific training will be restricted to ;

   A. Uphill running

   B. Interval training

4. Experimental period will be delimited to 12 weeks.
5. To test the hypotheses, the following parameters will be analysed;

1. **Physical**

-Speed

-Cardio vascular endurance

- Explosive leg Strength

-Agility

-Flexibility

2. **Physiological**

-Anaerobic power

-Vital capacity

-Haemoglobin

3.Football Playing Ability

-Dribbling

-Shooting

-Passing

LIMITATIONS

1. Certain factors like lifestyle, daily routine, diet and climatic condition will not be taken into account in the study.
2. Influence of vigorous academic activities of students can discourage or motivate the subjects during training and testing
3. The heterogeneous character of the subjects in hereditary and environmental factors will be recognised as limitations.
4. The subjects' body type and socio-economic status of the students will not be taken into consideration.

HYPOTHESES

1. It is hypothesised that there will be significant effect on selected physical and physiological variables due to uphill running and interval training among the young soccer players.
2. It is hypothesised that there would be significant effect on overall playing ability due to uphill running and interval training among the young soccer players.
3. It is hypothesised that there will be significant difference in the effect of uphill running and interval training on playing ability and selected variables.

SIGNIFICANCE OF THE STUDY

1. This study will provide detailed information about physical fitness variables associated with uphill running and interval training over twelve weeks of training.
2. The findings of the study will help coaches and physical educators to train their sports persons based on new concepts in improving their performance.
3. A unique aspect of this work is that it includes recommendations for the practical use of research findings.

4. The result of the study may be useful to the professional colleagues of physical education and sports in strengthening their knowledge about the uphill running and interval training program and its effect.
5. This study would also help the players to know about the impact of uphill running and interval training on playing ability of soccer players.
6. Findings of the study will help coaches to decide the desirable training methods to improve the playing ability of soccer players.

DEFINITION AND EXPLANATION OF TERMS

Training

Training is a pedagogical process, based on scientific principles, aiming at preparing sportsmen for higher performance in sports competitors.

Uphill Running

Uphill running is a method of running up a gentle to moderate hill with slope of 2.80 -5.80 (Derek D. Ferley, Roy W. Osborn, & Matthew D. Vukovich., 2013)

Interval training

Interval training is a type of training that involves a series of low- to high intensity workouts interspersed with rest or relief periods (Hardayal Singh, 1991).

Speed

It is the quality of a leg muscle to contract forcefully in the quickest possible time (Weinberg S. Robert and Daniel Gould, 1995).

Haemoglobin

A protein inside red blood cells that carries oxygen from the lungs to tissues and organs in the body and carries carbon dioxide back to the lungs.

Vital Capacity

Vital capacity (VC) is the maximum amount of air that a person can expel from the lungs after first filling the lungs to their maximum extent.

Anaerobic Power

Anaerobic power is the maximal power (work per unit time) developed during all-out, short-term physical effort; reflects energy-output capacity of intramuscular high-energy phosphates(ATP and PCr) and/or anaerobic glycolysis.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

Leite (2016) reviewed the physiological demands in football in his review "Physiological Demands In Football, Futsal And Beach Soccer: A Brief Review". In it, he highlighted the following facts and points.

1. Almost all (90%) of the energy required for the game time of 90 minutes comes from aerobic metabolism.
2. In a match, a football players runs on average 10-13 km
3. VO2 max values between 50-75 ml·kg 1·min-1 according to the different field positions
4. Top players during the entire duration of the match get involved in about 150-250 actions of 15-20 m high intensity exercise
5. There is a sprint performed every 90 seconds with an average of 2-4 seconds for each sprint
6. Sprints make up about 1-11% of the total distance covered during a game corresponding to 0.5-3% of the effective time play. They sprints are almost always less than 30m, half of them being lesser than 10m.
7. Nevertheless, these sprints play a decisive part in a football match.
8. Unlike beach soccer and futsal, there is greater need for both aerobic capacity and muscle strength.

Ziemann et al. (2011) conducted a study to investigate both aerobic and anaerobic benefits of high-intensity interval training performed at work-to-rest ratio of 1:2. For the purpose of the study 21 male active players were selected as subjects by randomly assigning 10 of them to training and 11 to control group. The interval training underwent a cycling power output equivalent to 80% of Vo2 max for 6 repetitions of 90 seconds followed by a 180 seconds rest for 3 sessions per week for 6 weeks performed on stationery cycle ergometer. The variables assessed for pre-test and post-test were Vo2 max, anaerobic threshold, work output, glycolytic work, mean power, peak power, max power, blood lactate. An 11% increase in Vo2 max($ml.kg^{-1}.min^{-1}$) for the interval training group was observed. The interval training group also improved in several anaerobic performance variables compared to control group. Work output($J.kg^{-1}$) increased 4.3% for interval training group but only by 1.4% for control group. Statistical test, group x time repeated-measures analyses of variance revealed that the interval training group improved Vo2 max(5.5 $ml.kg^{-1}.min^{-1}$), anaerobic threshold(3.8 $ml.kg^{-1}.ml^{-1}$), work output(12.5 $J.kg^{-1}$), glycolytic work(11.5 $J.kg^{-1}$), mean power(0.3 $W.kg^{-1}$), peak power(0.4 $W.kg^{-1}$) and max power(0.4 $W.kg^{-1}$);$p<0.05$. It was concluded that inclusion of such a protocol into a training program may rapidly restore or improve a client's or athlete's maximal functional capacity. This training protocols reduces preseason training requirements and is a very time efficient method. For the tennis players who lost 4–15% of their aerobic capacity during a 3–6 weeks break (31) and for other athletes, their HIIT protocol with a 1:2 work-to-rest ratio might be a time-efficient means to counter detraining during the off season.

Thanalakshmi (2022) undertook a study to assess the combined effect of anaerobic and interval training on maximal voluntary ventilation and vital capacity of volleyball players. 30 subjects in the age range of 18-25 years were selected as subjects and were further divided into two equal groups as training group(Group 1) and control group(Group II) with 15 subjects in each groups. Group I underwent combined training (anaerobic and interval training), group II acted as control they did not participating any activities. Experimental group have training programmes for 12 weeks in alternative days. For that purpose, the maximal voluntary ventilation and vital capacity selected as dependent variables for this study. Maximal voluntary ventilation and vital capacity measured by spirometry test. Analysis of Covariance (ANCOVA) was applied as statistical tool for the study, significant at 0.05 level of significance. Post training intervention, maximal voluntary ventilation(131.14± 2.54) in combined training group and vital capacity(4.15±1.48) were significantly different with post test of control group's maximal voluntary ventilation(124.98±2.54) and vital capacity(4.61 ± 1.83). With an obtained 'f' ratio of 5.24 and 6.84 for both maximal voluntary ventilation and vital capacity respectively, it was concluded that 12 weeks of combined anaerobic and interval training greatly improved both the parameters in the subjects significantly.

Taufik et al. (2021) conducted a study to determine the effect of interval training and circuit training on increasing VO2 max capabilities of 30 futsal players. Selection of the subjects was done through random sampling from a futsal academy and they were divided into two equal groups (each 15) of interval training group and circuit training. The dependent variable tested was maximal oxygen consumption (VO2 Max). The study was carried out for two months with 18 sessions, performing three sessions per weeks. During the whole course of the training, subjects performed a warm up routine in the form of interval workout and accelerating circuit training. The pretest-posttest group design was used for the study. Multi stage test using bleep was used as instrument for the study and it was administered before and after the completion of the training program. This test consists of 23 levels where each level lasts about one minute. ANOVA was used to analyze the obtained data. There was a significant improvement in the the VO2 max of the players in both the interval and circuit training group. However, from the bleep test, VO2max increased by 0.881 for the circuit training group with a value of 0.00 <0.05 and the value was 0.631 for interval training group for the paired t-test with a value of 0.00 <0.05. It was concluded that circuit training was better for in terms of the effect on the improvement of VO2 max. The researchers recommend circuit training as a preferred mode of training for football player as it can influence both aerobic capacity and VO2 max endurance in combination with technique, tactics and physicality development.

Lemire et al. (2015) conducted a study to compare the oxygen consumption(VO2), heart rate(HR) and ventilation(VE) during uphill and downhill running with well-endurance athletes by exposing them to the same mechanical stress. For the purpose of the study, 8 athletes were selected and they first underwent incremental test to determine their speed related to maximal oxygen consumption(VO2 max). Thereafter, the subjects did an uphill exercise running(+15%) which was succeeded by 15 minutes downhill (-15%) subjected to the same mechanical stress(50% of VO2 max). The two exercises had 10 minutes recovery between them. Oxygen consumption, heart rate and ventilation were recorded before and after both uphill and downhill exercise. It was later found out that all the mentioned variables were significantly lower during downhill exercise.Although the Downhill-Uphill ratio were same in oxygen consumption and ventilation(35.8±1.7 and 36.2±1.5), it was higher in heart rate(75.4±2.2). The lower ventilation seen during DH exercise was attributed to a lesser tidal volume while respiratory frequency remained the same. Blood lactate after UH exercise reached 13.9±2.3 mmol/L and was low after DH (1.6±0.2 mmol/L). They came to a conclusion that the same mechanical stress DH exercise

leaded to a lower V̇O2 as shown in other eccentric muscle work models but in a less extent than cycling. It appeared also that breathing pattern was differently affected by DH (i.e. eccentric) exercise. In case of trail running race, the changes in blood lactate observed after DH exercise may promote lactate elimination.

Madathil et al. (2018) conducted a study to find out the effect of uphill training on football players on the performance of speed, acceleration and stride rate. 24 subjects, males and females were selected as subjects using the random sampling technique of which they were divided into two equal group namely experimental and control group. The duration of the training program was for 2 months consisting of 3 days per weeks and each session lasted for 50 minutes. The dependent variables were speed, acceleration, and stride rate. The training program which was of 20 minutes began with warm up exercises lasting 15 minutes. Exercise intensity started at 80% maximum heart rate and was increased to 100% maximum heart rate before the end of the training program. Paired T-test was the statistical technique used and the selected variables were tested before and after training program. This study revealed that uphill training with active rest was crucial to improve the speed, acceleration and stride rate of football players. The mean difference (MD) between pre and post tests for speed for females was 0.15m/s and 0.22m/s, males achieve 0.12mls and 0.33m/s both control and experimental groups respectively; acceleration was females achieve 0.06m/s2 and 0.10m/s2 and males achieve 0.05m/s2 and 0.20m/s2 both control and experimental groups respectively and the stride rate was also females 0.06strides/second and 0.56strides/second and male 0.21strides/second and 0.71strides/second of the control and experimental group respectively. The main finding of the study was that football players who were exposed to uphill training have discovered positive result in speed, acceleration and stride rate.

Anitha (2020) conducted a study to find out the effect of continuous training and interval training on hematological variables among university male students. 45 men students age ranging from 18 to 25 years were randomly selected as subjects from Chennai, Tamil Nadu. The subjects were divided into experimental group 1, experimental group II and control group III who underwent continuous training, interval training and control group respectively. The selected hemotological variables were hemoglobin, Red Blood Cell count and White Blood Cell count. Training was administered for 12 weeks won alternative days in a week. Pretest and Posttest were conducted before and after the training program. The collected data were statistically analyzed using the Analysis of Covariance(ANCOVA) and Scheffe's post hoc test was used to determine the significant difference between the paired adjusted means at 0.05 level of significance. The adjusted post-test means of continuous training group, interval training group and control groups and control groups were 13.79, 13.83 and 13.02 respectively. The obtained 'F' ratio of 67.18 for adjusted post-test means was greater than the table value of 3.23 for degrees of freedom 2 and 41 required for significance at 0.05 level of confidence on hemoglobin which shows that there was a significant difference among the adjusted post-test means of continuous training group, interval training group and control groups. The mean difference values between continuous training group & control group, interval training group & control group, interval training group & continuous training group, are 5.94, 5.95 and 5.35 respectively which are greater than the confidence interval value 0.24 at 0.05 level of confidence and this showed that continuous training group responded to the training with more positive influences of red blood cells count (RBC) when compared with the interval training group and control group. The interval training group responded better when compared with the control group. The adjusted post-test means of continuous training group, interval training group and control groups and control groups are 9606.69, 9526.63 and 8933.3 respectively. The obtained 'F' ratio of 52.49 for adjusted post-test means was greater than the table value of 3.23 for degrees of freedom 2 and 41 required for significance at 0.05 level of confidence on white blood cells count (WBC). Continuous training group responded to the training with more positive influences of white blood cells

count (WBC) when compared with the interval training group and control group. The interval training group responded better when compared with the control group.

Hindistan et al. (2020) conducted a study to determine the effects of sprint interval training on sloping surfaces on anaerobic and aerobic power. 34 recreationally active men(20.6±1.68 years), having a BMI of 21.77±1.74 were randomly assigned to control(CON), uphill training(EXP_1), downhill training(EXP_2), uphill+downhill training(EXP_3) and horizontal running training(EXP_4) and given training for a period of eight weeks for three days in a week. Sprint imterval training was gradually increased with performance on horizontal and sloping surfaces with an angle of 4º. Pre and Post aerobic power was measured with an oxygen analyser and anaerobic power was measured using the Margaria-Kalamen staircase test. Initial measurement of both aerobic and anerobic measurement were made only after 2 weeks of general strength training. Participants in EXP_1, EXP_2, and EXP_4 groups undertook a 4-set training programme, each sets having 4 repetitions. One additional repeat was added to the 1st and 3rd sets at the 5th and 6th weeks of training based on the principle of increasing the load in the training programme. At the 7th and 8th weeks, 1 additional repeat was added to the 2nd and 4th sets and the participants performed 5 repetitions in each set until the end of the study. In the EXP_3 group, on the other hand, participants performed a 2-set training programme with longer distance as stated in detail below, with each set consisting of 4 repeats. In this group, an additional repeat was inserted into the 1st set in the 5th and 6th weeks of the training. At the 7^{th} and 8^{th} weeks, 1 repeat was added to the 2^{nd} set and both sets were applied for total 5 repeats again. After the training program, an increase in aerobic power was observed in all training group(Uphill training=20.79%, downhill training=14.95%, uphill+downhill training=26.85% ,$p<0.01$) and (horizontal running=20.46%)($p<0.05$) in comparison with the control group(0.12%) but no significant differences were observed among the training group. But there was a significant increase in anaerobic power in uphill training (4.91%) and uphill+downhill training(8.35%) groups ($p<0.5$). It was concluded that horizontal and sloping surfaces have a positive effect on aerobic power, and uphill and combined training were the most effective methods for the improvement of anaerobic power.

Foster et al. (2015) performed a study to compare the effects of two HIIT protocols vs steady-state training on aerobic and anaerobic capacity following 8-weeks of training. 55 untrained college-aged subjects(23 male, 42 female) were randomly assigned to 3 training groups (3x weekly). Steady-state (n = 19) exercised (cycle ergometer) 20 minutes at 90% of ventilatory threshold (VT). Tabata (n = 21) completed eight intervals of 20s at 170% VO2max/10s rest. Meyer (n = 15) completed 13 sets of 30s (20 min) @ 100% PVO2 max/ 60s recovery, average PO = 90% VT. Each subject did 24 training sessions during 8 weeks. Results: There were significant ($p < 0.05$) increases in VO2max (+19, +18 and +18%) and PPO (+17, +24 and +14%) for each training group, as well as significant increases in peak (+8, + 9 and +5%) & mean (+4, +7 and +6%) power during Wingate testing, but no significant differences between groups. Measures of the enjoyment of the training program indicated that the Tabata protocol was significantly less enjoyable ($p < 0.05$) than the steady state and Meyer protocols, and that the enjoyment of all protocols declined ($p < 0.05$) across the duration of the study. The results suggested that although HIIT protocols are time efficient, they are not superior to conventional exercise training in sedentary young adult.

Chittibabu (2014) did a study to find out the effect of high intensity interval training on aerobic power and anaerobic power of male handball players. (30) male handball players(aged 21 to 26 years) were selected from Department of Physical Education and Sports Sciences, Annamalai University, Tamil Nadu, India. Selected subjects were classified into two groups namely Group I: High intensity interval training and Group II: Control

group. They were tested on aerobic power and anaerobic power before and after eight weeks of high intensity interval training (HIIT) using Multistage Fitness Test and Running Based Sprint Test(RAST) respectively. Aerobic training was given for 4 days per week. . The result of the study revealed that eight weeks of high intensity interval training resulted in 8.20% of improvement in aerobic power ($F(1,27) = 108.04$, $p < 0.05$) and 28.58% in anaerobic power ($F(1,27) = 28.54$, $p < 0.05$). It was agreed that a consequent adaptive response cardiorespiratory fitness could be triggered by the training program.

Lember et al. (2021) performed a study to describe anthropometric variables, aerobic capacity, running performance and energy intake and expenditure of hill runners in free-living conditions, and to better understand the relationship between age, anthropometric variables, aerobic capacity and running performance. 28 hill runners(17 males and 11 females) aged 18-65 years participated in the study. The variables assessed were body fat percentage estimate, sum of eight skinfolds ,maximal oxygen capacity (VO2max), oxygen consumption, energy expenditure, and energy intake. The study used a between participants, cross sectional design and the subjects attended the designated testing facilities for two time: once for a lab- based test and the second for field-based testing session with 72 hours in between. Results showed that participants were more mesomorphic than endomorphic and ectomorphic. There was a negative correlation between running performance and body fats percentage and sum of eight skin folds. A significant negative relationship was observed between age and average energy intake. There was also a relationship between aerobic capacity and age. The study pointed out that greater aerobic capacity leads to better hill running performance and hill runners are at a risk of negative energy balance. They also suggested that hill running can slow age induced declines in maximal aerobic capacity and body fats increase.

Sloniger et al. (1997) conduct a study to find out the extent and pattern of lower muscle activation during horizontal and uphill-high intensity running(115% of peak oxygen uptake) to exhaustion in 12 young women by using exercise-induced contrast shifts in magnetic resonance(MR) images. It was found out that the volume of lower body muscles activated was greater during uphill running(73±7%) than during horizontal running(67±8%). The muscles most activated were the adductors (90± 5%), semitendinosus (86±13%), gracilis (76±20%), biceps femoris (76±12%), and semimembranosus (75±12%) during horizontal running. During uphill running, the muscles most activated were the adductors (83±8%), biceps femoris (79±7%), gluteal group (79±11%), gastrocnemius (76±15%), and vastus group (75±13%). Uphill running needs more activation of the vastus group(23%) and soleus(14%) compared to horizontal running and less activation of the rectus femoris(29%), gracilis(18%) and semitendinosus(17%). It was concluded that the muscles of the lower extremity are not maximally activated during horizontal and uphill running to exhaustion and extra muscle mass should be recruited to demand the need for force and energy.

Wang and Zhang (2022) investigated the effect of high intensity interval training on soccer players' performance. To accomplish the objective, 30 soccer players students of a university were selected as subjects who were divided equally into experimental group and control group. The experimental group performed high intensity interval training and the experimental group practiced traditional aerobic resistance training methods. Indicators information/dependent variables such as Physical fitness(12 min run, 30 m sprint, 40 m sprint and bounce), FMS index(deep squat, hurricane, straight bow arrow, shoulder flexibility, practice straight knee leg, torso stability pushups, torso rotation stability were collected before the start of the training and at the end of the six weeks training. The duration of the training lasted for 6 weeks and 4 training sessions were conducted each

week. The data obtained after the end of training program revealed that physical fitness of the experimental group was greater than that of the control group, thereby proving the effect of high-intensity interval training on physical fitness is better than that of traditional aerobic training. Results also suggested that high-intensity interval training can promote the optimization of FMS indexes of football players, so as to improve their sports performance. When comparing and analyzing the results of the experimental group and the control group, it was seen that both sports methods can optimize the FMS test results of football players, but the improvement range of the experimental group was significantly greater than that of the control group. HIIT can be made an integral part of football training for the promotion of physical quality and flexibility, reduction of sports injuries, improvement of physical condition, etc.

Fleckenstein et al. (2021) performed a study to find out the effect of uphill running on vo2, heart rate and lactate accumulation on lower body positive pressure treadmills. 10 well-trained runners(30.2±3.4 years;VO2 max:60.3±4.2mL $kg^{-1}min^{-1}$) performed a run at 70% of their maximal VO22 max on a Low Body Positive Pressure Treadmill at 80% bodyweight support and 90% bodyweight supports at 0%, 2%, 7% incline. Oxygen consumption (VO2), heart rate (HR) and blood lactate accumulation (LACTATE ACCUMULATION) were the variables tested. An increase in incline led to increased VO2 values of 6.8 ± 0.8 mL kg−1 min−1 (0% vs. 7%, $p < 0.001$) and 5.4 ± 0.8 mL kg−1 min−1 (2% vs. 7%, $p < 0.001$) was observed. Between 80% Between set and 90% Between set, there were VO2 differences of 3.3 ± 0.2 mL kg−1 min−1 ($p < 0.001$). HR increased with incline by 12 ± 2 bpm (0% vs. 7%, $p < 0.05$) and 10 ± 2 bpm (2% vs. 7%, $p < 0.05$). From 80% Between set to 90% Between set, HR increases of 6 ± 1 bpm ($p < 0.001$) were observed. Also lactate accumulation values showed differences of 0.10 ± 0.02 mmol l−1 between 80% Between set and 90% Between set. Those results suggest that on a LBPPT, a 2% incline (at 70% vVO2max) is not yet sufficient to produce significant physiological changes in VO2 , HR and LACTATE ACCUMULATION—as opposed to running on conventional treadmills, where significant changes are measured. However, a 7% incline increases VO2 and HR significantly. Bringing together physiological and biomechanical factors from previous studies into this practical context, it appears that a 7% incline (at 80% Between set) may be used to keep VO2 and HR load unchanged as compared to unsupported running, while biomechanical stress is substantially reduced.

Selvam and Sundar (2018) conducted a study to find out the effect of uphill training on selected physical and physiological variables among long distance runners. 30 male long-distance runners (18-25 years) volunteered as subjects and were divided equally randomly into experimental and control group. The variables selected for pre and post-measurement were physical variables (speed endurance, cardio respiratory endurance), physiological variables(resting pulse rate, VO2 max). Speed endurance was measured by 600 m run, cardio respiratory endurance by Cooper's test, resting pulse rate by pulse rate, VO2 max by Harvard Step Test. The obtained data were analysed with Analysis of 't' ratio with the level of significance set at 0.05. Result showed that there was a significant improvement in selected physical and physiological variables among long-distance runners due to uphill training. Obtained 't' value of speed endurance was 12.92, cardiorespiratory endurance was 12.65, resting pulse rate was 6.32 and Vo_2 max was12.89 respectively which was greater than the required 't' value to be significant. For the degrees of freedom 2.15 at 0.05 level of confidence.

Yuwono and Rachman (2021) conducted a study to investigate the effect of uphill and downhill exercise on soccer player's leg power. 20 players from Sleman United football players were selected as subjects. They had passed muscle strength test and met the requirement for the study. The duration of the training was for

2 months, with 4 stages and each stage last for 2 weeks. The design of the study was based on 2x2 factorial research design. In stage 1, the subjects performed 5 reps and 4 sets with 1-minute intervals followed by a 15-second recovery. In stage 2, the subjects performed 6 reps and 5 sets with 1-minute interval followed by a 15-second recovery. In stage 3, the subjects performed 7 repetitions and 6 sets with 1-minute intervals followed by a 15-second recovery. In stage 4, the subjects performed 8 reps and 7 sets with 1-minute intervals followed by a 15-second recovery. The form of training starts from warm-up then proceeded to core training, namely uphill training by climbing 30-40m uphill roads by running and for downhill training by going down an incline of 30-40m by running. The leg muscle strength instrument was performed using the leg and back dynamometer test. Two-way ANOVA was used for the analysis of data. Result showed that there was a significant difference in the effect between uphill and downhill training on leg power of football players. There was also a significant interaction between uphill and downhill training with leg muscle strength (high and low) on leg power of football players. The results showed that the uphill training group was more appropriate for players with high leg muscle strength, while the downhill training group was suitable for players with low leg muscle strength. Players trained using uphill training with high leg muscle strength were better than players who were trained using downhill training with high leg muscle strength, with a p-value <0.05. Players trained using uphill training with high leg muscle strength were better than the group of players who were trained using uphill training with low leg muscle strength, with a p-value <0.05. Players trained with uphill training with high leg muscle strength showed better result than the group of players trained using downhill training with low leg muscle strength. Players trained using downhill training with high leg muscle strength were better than the group of players trained using downhill training with low leg muscle strength, with a p-value .

Padulo et al. (2013) studied the variables involved in uphill running. The variables studied were heart rate, heart rate variability, oxygen intake and blood lactate, metabolic cost, kinematics, ground reaction force and muscular activity. Eighteen high-level competitive male runners(age 33.068.5 [mean ± SD] years, mass 62.6±5.2 kg, height 1.71±0.04 m, BMI 21. ±1.0 kg/m2) ran at 70% VO2max on various uphill slope conditions: 0%, 2% and 7%. The data were collected during a single test session. Heart rate was measured using a heart rate monitor, oxygen intake by breath-by-breath metabolic measurement system, blood lactate by a lactate analyzer in $mmol.L^{-1}$, kinematics by high speed camera, reaction force by counting the frames in contact and flight on the 2D data, then dividing by the sampling rate, muscular activity by bipolar electrodes with Muscle Lab Encoder. Normality was checked using the Kolmogorov-Smirnov test, significant differences between all variables was determined with one-way analysis of variance (ANOVA). Post hoc tests were conducted when significant main effects were found using Fisher's least significant difference (LSD). Significance level was set at P#0.05

It was found out that modifications were significant in almost all variables studied, and were more visible with higher incline. Step frequency/length and ground reaction force were adjusted to deal with the task of uphill progression and the existing metabolic power. From 0% to 7% slope, step frequency and ground reaction force and metabolic cost increased concurrently by 4%, 12% and 53%, respectively (with a 4% step length decrease as well).

CHAPTER 3

PROCEDURE

3.1 Selection of subjects

Forty-five (45) male soccer players of a residential academy in Kohima with age ranging from 15 to 20 years will be pooled for this experiment. The criteria for inclusion and exclusion of the subjects will be as follow:

- The players who are the regular practitioners of soccer will be included in the experiment.
- The subjects who are expected to remain present till the experiments are finished will only be incorporated in this study.
- The players suffering from known serious health problems are to be excluded.

3.2 DESIGN OF THE STUDY

Making the use of lottery method, all the 45 subjects will be randomly divided into three groups viz,.

1. Group-A(Uphill running group)
2. Group-B(Interval training group)
3. Group-C(Control Group)

Group-A and Group-B will be involved for 40 minutes with their respective training schedule thrice a week (i,e Monday , Wednesday and Friday). Group C (control group) will not be subjected to any specific training and remain active with their usual activities. The total duration of the experiment will be of 12 weeks which include the training period, rest days, testing periods.

3.3. SELECTION AND ADMINISTRATION OF TEST

As per the available literature the following standardized test will be used to collect the relevant data on the selected dependent variables and playing ability for pre-test as presented in the following tables.

TABLE 1

TEST SELECTION FOR PHYSICAL VARIABLES

CRITERION VARIABLES	TEST ITEMS	UNIT OF MEASUREMENT
Speed	50 metres dash	Second
Cardio Vascular Endurance	12 minutes Run-Walk Test	Meter
Explosive leg Power	Vertical Jump (Sargent Jump)	Centimetre
Agility	Quadrant Jump	Point
Flexibility	Sit-and Reach Test	Centimetre

TABLE 2

TEST SELECTION FOR PHYSIOLOGICAL VARIABLES

CRITERION VARIABLES	TEST ITEMS/EQUIPMENT	UNIT OF MEASUREMENT
Vital Capacity	Spirometer	Cubic centimetre ($Cm^{3)}$
Anaerobic Power	Margaria-Kalamen Power Test	Kg-meters per second
Haemoglobin	Hemocue Hb201DM System	mmol/L

TABLE 3

TEST SELECTION FOR PLAYING ABILITY

(Mor and Christian Soccer Playing Ability Test)

CRITERION VARIABLES	UNIT OF MEASUREMENT
Passing	Count
Shooting	Count
Dribbling	Second

TRAINING /TREATMENT

After pre-test is over, the subjects of experimental group (Group-A and Group-B) will undergo different training schedules as stated earlier.

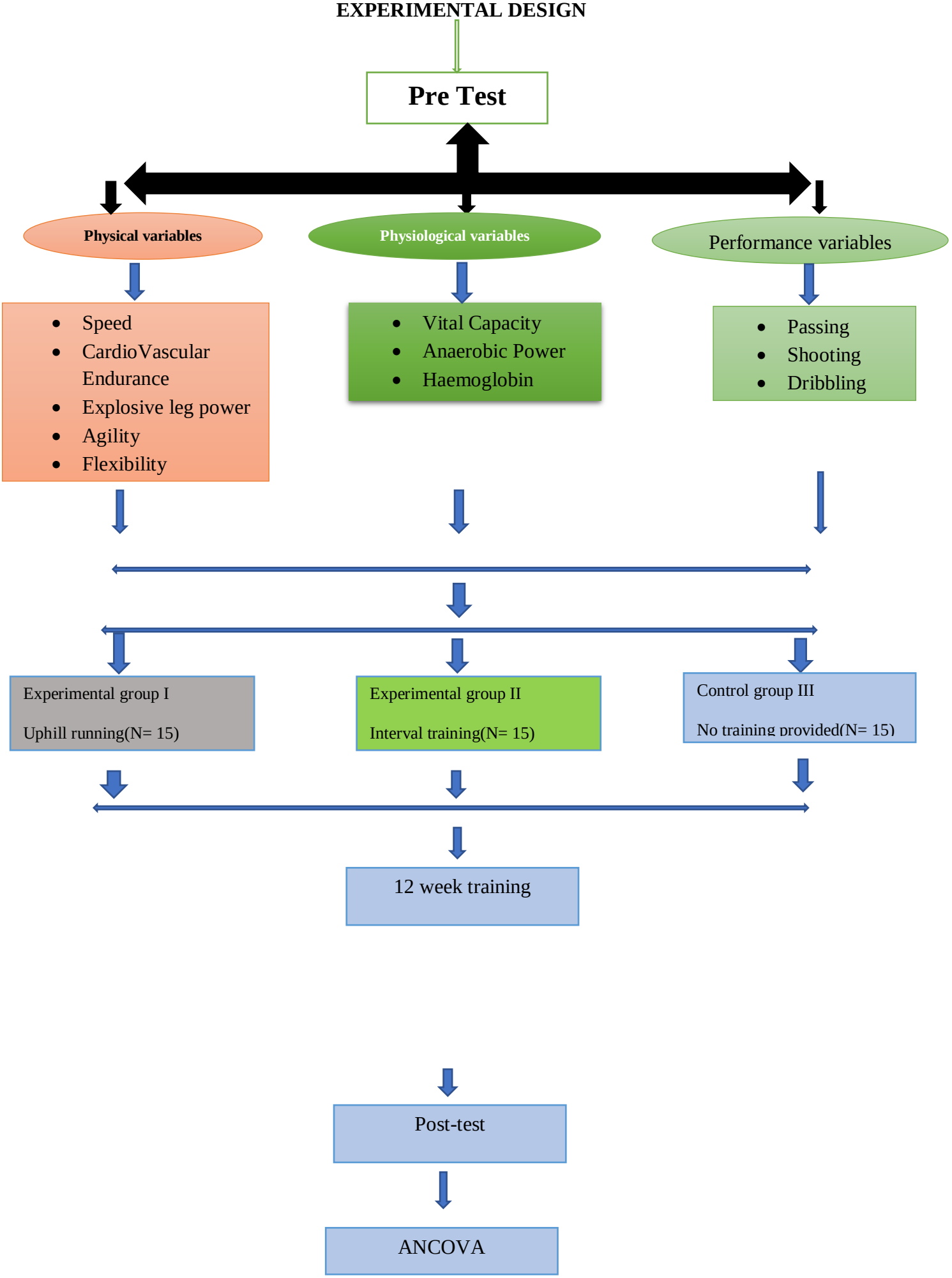
POST-TEST

After completion of 12 weeks training/treatment, the subjects of all the three groups will be tested again on the same variables and playing ability.

EXPERIMENTAL DESIGN

Pre-test and post-test randomized design will be used for this study as all subjects will be randomly selected and divided into three groups i.e. one experimental (uphill running), second experimental (interval training) and one control group. The two experimental groups will participate in their respective training to find out the effect and the control group will not participate in any training programme.

EXPERIMENTAL DESIGN



3.4 COLLECTION OF DATA

The data on physical, physiological variables and playing ability will be collected on the schedule as given below;

Day 1: Physical and Physiological variables

Day 2: Playing Ability

Physical and physiological variables will be tested on day 1 while playing ability will be tested on day 2 before and after the administration of training.

STATISTICAL TECHNIQUES EMPLOYED.

With the level of significance fixed at 0.05, the following statistical tests/techniques will be used.

1. Dependent T-test; to determine whether there is any statistically significant pre-test to post-test mean differences in their respective variables of each group.
2. Analysis of Covariance Statistical methods will also be employed to find out the difference among the groups as the groups were selected at random and not equated. If F-test is found to be significant, to determine the paired mean difference LSD Post hoc test will be employed.

CHAPTER 5

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